

the progress of a thunderstorm. Thunder was first heard at 3:28 p. m.,¹ and last at 5:42 p. m. During this interval there were two distinct storms; both came from the west and moved toward the east. The first past to the south with no rainfall at this station, and before it was beyond the range of hearing the second came up and past just north of the station, causing rain from 4:44 to 5:02 p. m., amounting to .57 inch, most of which fell between 4:50 and 4:59 p. m. Hailstones of various sizes began falling at 4:38 p. m. (six minutes before the rain began) and ended at 4:54 p. m. All hailstones were flat and elongated, with sharp edges. Many were three-fourths of an inch in diameter the longest way. Some that were examined closely were frozen solid, with crystal ice at center, while the nuclei of others were amorphous ice. A few were found with holes thru them at the center on the flat side, having a shape like an elongated ring or hollow doughnut. It is believed that this form was due to the center being water, or raindrops, that were liberated by the melting of the sides of the hailstones when exposed to a temperature above freezing. Some of the largest hailstones had water, apparently fair-sized raindrops, in the center, while they were frozen solid on the outside, indicating that they froze after the formation of raindrops, and were not subjected to freezing temperature long enough to cause them to become solid ice. Only a few of the nuclei of those examined contained air bubbles, while many of the small ones were clear ice, making the entire hailstone appear one solid piece of ice. From the observation it appears that the centers or nuclei of all depended solely upon the surrounding temperature during and after the condensation of the vapor in the atmosphere. Those with centers not solid were constructed of only one solid layer of ice over the nucleus, the thickness depending on the size of the hailstone. The peals of thunder and flashes of lightning did not appear to have any connection with the fall of hail; lightning was visible and the sun came out during the latter part of the hailstorm. The wind velocity was light.

SPECIAL TEMPERATURE OBSERVATIONS MADE ON LOW GROUND IN THE VICINITY OF VICKSBURG, MISS.

By W. S. BELDEN, Section Director. Dated Vicksburg, Miss., May 22, 1907.

It is a well-known fact that on relatively clear nights, with light wind velocity, the temperature is lower in lowlands and valleys than on adjacent uplands. The records of the Weather Bureau show that under these weather conditions the night temperature in cities is higher than that which prevails in the surrounding open country of the same elevation; this difference is largely attributed to the fact that the superincumbent atmosphere is freer from dust motes over the country than over the city, a condition which promotes radiation from the earth's surface in the former case and retards it in the latter.

Frost is frequently reported from regular Weather Bureau stations with a minimum temperature of between 44° and 50°, the frost being generally noted in the suburbs of the city and the temperature readings made in the densely populated portion of the city [within shelters elevated on high buildings].

In order to secure more definite information along this line for Vicksburg and vicinity, a series of special observations covering the months of October and November, 1906, and March and April, 1907, was undertaken by the writer.

Two substations were established on low ground near the city, each being equipped with a maximum and a minimum thermometer, exposed in a cotton-region thermometer shelter. Both shelters were located over sod, with floors 4 feet above the ground. One of the substations, which we will call Station A, was situated in Marcus bottom, a narrow valley about one mile southeast of the observation station. There were no trees

or high objects near the shelter. The thermometers were 172 feet above sea level. At the place of observation the valley was only about 150 yards wide, with rather steep bluffs on either side, and the drainage area of the valley to the point of observation was two and one-fourth square miles. The other substation, which we will call Station B, was located about two miles north of the regular observation station and in the Yazoo River bottom, near the National Cemetery. The shelter was placed at the center of a circular plot of sodded ground about 200 feet in diameter, and the nearest high object was a large one-story frame building, used as a box factory, 150 feet west of it. The thermometers were 108 feet above sea level. The Yazoo bottom is several miles wide at the point where observations were made, the station being located 160 feet from the east edge of the valley.

Station A may safely be taken as typical of meteorological conditions that prevail in the numerous narrow valleys to the south and east of Vicksburg, while Station B represents conditions in the low and level lands west and north of the city.

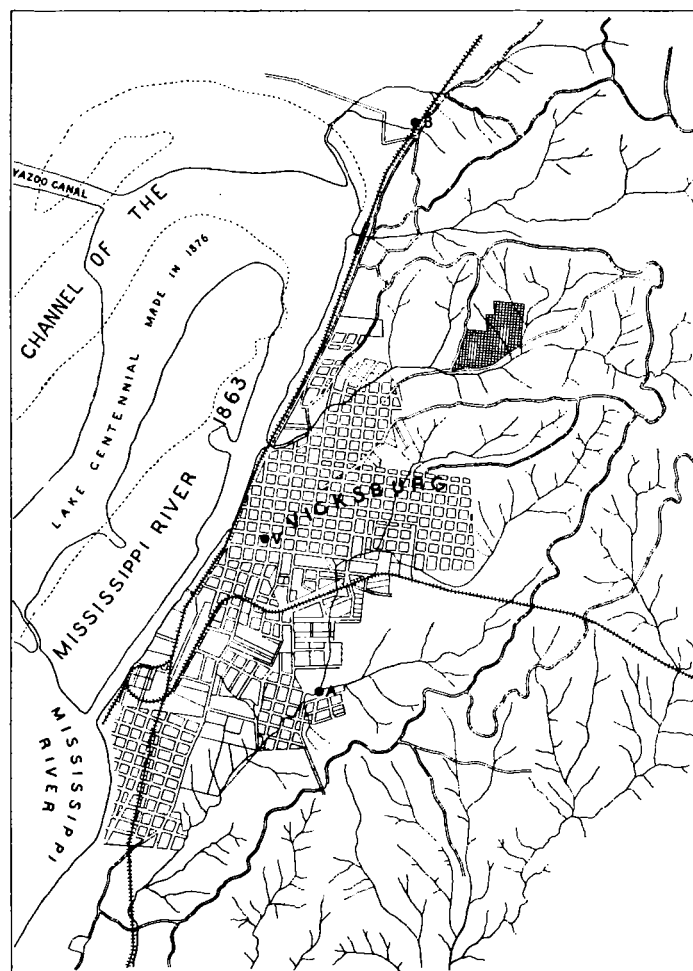


FIG. 1.—Map of the vicinity of Vicksburg, Miss., showing location of the three stations.

At the Vicksburg station the thermometers are located on the post-office building, 63 feet above ground and 289 feet above sea level. A map of Vicksburg and vicinity, showing the location of the three observation stations is reproduced (see fig. 1). Observations were carefully made at the substations at about sunset, and the temperature values of the Vicksburg station that are used in this discussion are based on maximum and minimum readings for the twenty-four hours ending at 7 p. m., local standard time [ninetieth meridian time].

¹ Seventy-fifth meridian time is used.

TABLE 1.—Record of special temperature observations made in the vicinity of Vicksburg, Miss.

MARCH, 1907.

Date.	Vicksburg.			Station A.			Difference.*	Weather in early morning.	Average velocity, mid. to 6 a. m.	Humidity, 7 a. m.
	Maximum.	Minimum.	Range.	Maximum.	Minimum.	Range.				
1	70.0	55.0	15.0	70.3	55.8	14.5	-0.2	Cloudy	m. p. h.	%
2	64.9	48.0	16.9	66.0	39.0	27.0	-7.0	Clear	11.0	89
3	74.6	53.0	21.6	73.8	39.7	34.1	-13.3	Clear	5.6	86
4	75.6	52.5	23.1	76.0	46.5	29.5	-6.0	Clear	3.7	58
5	76.8	55.8	21.0	78.0	53.2	24.8	-5.6	Partly cloudy	12.2	92
6	71.6	54.2	17.4	71.6	52.5	19.1	-1.7	Cloudy	6.9	58
7	78.5	58.7	19.8	80.0	56.0	24.0	-2.8	Cloudy	7.3	67
8	75.4	64.0	11.4	75.0	63.5	11.5	-0.5	Cloudy	9.0	95
9	79.4	56.3	23.1	81.2	53.8	27.4	-0.5	Cloudy	6.9	96
10	75.6	63.8	11.7	74.8	61.7	13.1	-2.1	Cloudy	8.3	96
11	77.5	46.5	31.0	78.4	45.6	32.8	-0.9	Clear	9.5	94
12	82.4	67.0	15.4	84.4	56.4	28.0	-0.6	Cloudy	6.9	82
13	80.0	69.2	10.8	81.5	68.3	13.2	-0.4	Partly cloudy	10.9	83
14	78.9	47.0	31.9	79.0	47.9	31.1	+0.9	Cloudy	11.5	77
15	64.4	43.0	21.4	64.8	41.2	23.6	-1.8	Partly cloudy	8.2	91
16	70.8	45.3	25.5	73.4	36.0	37.4	-9.3	Clear; lt. frost	7.5	74
17	80.1	59.5	20.6	80.6	52.8	27.8	-6.7	Cloudy	5.0	61
18	82.5	68.1	14.4	84.0	58.6	25.4	-4.5	Cloudy	5.3	94
19	83.4	65.7	17.7	84.0	63.9	20.1	+0.2	Partly cloudy	10.7	90
20	85.2	64.3	20.9	87.0	64.4	22.6	-0.4	Clear	7.9	98
21	85.2	62.1	23.1	86.9	56.7	30.2	-5.4	Cloudy	7.0	95
22	88.0	64.7	23.3	88.0	61.0	27.0	-3.7	Cloudy	7.2	94
23	89.2	63.0	26.2	84.5	61.2	23.3	-1.8	Partly cloudy	6.0	92
24	85.5	65.4	20.1	86.5	58.5	28.0	-6.9	Clear	6.9	92
25	83.2	65.0	18.2	83.1	53.3	29.8	-9.7	Cloudy	6.2	90
26	87.6	64.0	23.6	88.8	56.0	32.8	-8.0	Clear	7.2	97
27	85.6	65.6	20.0	87.0	63.2	23.8	-2.4	Cloudy	8.0	92
28	84.6	66.7	17.9	85.6	65.9	19.7	-0.8	Cloudy	8.5	92
29	82.4	66.8	15.6	83.8	64.7	19.1	-2.1	Partly cloudy	4.4	98
30	68.5	59.5	9.0	67.0	58.4	8.6	-1.1	Cloudy	9.3	74
31	61.5	50.2	11.3	63.2	48.0	15.2	-2.2	Cloudy		
Sums...	2417.8	1830.5	587.3	2443.2	1723.2	720.0	-107.3		238.8	2661
Means...	78.0	59.0	18.9	78.8	55.6	23.2	-3.4		7.7	86

APRIL, 1907.

1	60.5	41.3	19.2	61.2	37.4	23.8	-3.9	Clear	11.3	52
2	66.0	40.0	26.0	66.4	30.3	36.1	-9.7	Clear; b'y frost	6.9	46
3	73.5	47.5	26.0	75.1	36.7	38.4	-10.8	Clear; lt. frost	8.3	55
4	74.0	57.1	16.9	75.5	56.3	19.2	-0.8	Cloudy	8.5	83
5	69.5	57.3	12.2	71.2	55.0	16.2	-2.3	Cloudy	9.7	97
6	70.4	53.8	16.6	72.0	55.8	16.2	-0.0	Cloudy	8.2	93
7	80.0	62.5	17.5	81.0	61.0	20.0	-1.5	Cloudy	10.5	89
8	72.0	58.6	13.4	74.3	48.5	25.8	-10.1	Clear	4.3	76
9	68.8	45.3	23.5	70.2	36.8	33.4	-8.5	Clear	6.5	63
10	67.1	52.2	14.9	69.2	41.0	28.2	-11.2	Clear	7.2	54
11	77.6	48.0	29.6	79.0	45.3	33.7	-2.7	Cloudy	7.5	47
12	75.9	53.5	22.4	74.0	51.8	22.2	-1.7	Clear	6.0	65
13	66.3	45.0	21.3	71.5	46.9	24.6	-1.1	Clear	10.2	48
14	58.4	46.6	11.8	59.8	39.3	20.5	-7.3	Cloudy	6.0	46
15	72.3	51.0	21.3	73.4	48.4	25.0	-2.6	Cloudy	6.7	59
16	80.9	64.7	16.2	81.7	64.5	17.2	-0.2	Cloudy	10.0	85
17	71.2	48.6	22.6	69.8	48.6	21.2	-0.0	Cloudy	8.7	94
18	77.2	50.5	26.7	79.2	50.2	29.0	-0.3	Cloudy	3.9	100
19	72.6	50.2	22.4	74.6	49.5	25.1	-0.7	Cloudy	6.9	80
20	62.0	46.8	15.2	62.8	45.5	17.3	-1.3	Partly cloudy	7.2	74
21	58.2	47.3	10.9	57.8	46.8	11.0	-0.5	Cloudy	7.7	94
22	61.0	54.0	7.0	61.9	53.8	8.5	-0.6	Cloudy	6.0	95
23	63.4	48.0	15.4	60.0	47.8	12.2	-0.2	Clear	10.5	86
24	73.4	51.0	22.4	75.1	41.8	33.3	-9.2	Partly cloudy	2.2	78
25	75.4	59.8	15.6	75.9	54.9	21.0	-4.9	Partly cloudy	7.5	78
26	77.8	63.8	14.0	80.1	63.5	16.6	-0.3	Cloudy	7.3	92
27	78.4	59.4	19.0	79.8	57.8	22.5	-2.1	Cloudy	2.7	97
28	84.6	61.3	23.3	86.0	60.5	25.5	-0.8	Cloudy	6.7	90
29	82.8	65.9	16.9	84.0	61.6	22.4	-4.3	Cloudy	5.0	98
30	72.7	56.4	16.3	78.0	57.0	21.0	+0.6	Cloudy	8.5	88
Sums...	2143.9	1592.4	551.5	2180.5	1493.4	687.1	-99.0		218.6	2316
Means...	71.5	53.1	18.4	72.7	49.8	22.9	-3.3		7.3	77

*Difference between minimum temperatures; or Station A minus Vicksburg.

On 15 mornings during the four months the minimum temperature at Station A was more than 10° lower than that observed at the Vicksburg station. These extreme differences occurred when local weather conditions were being dominated by high barometric pressure. The average hourly wind velocity (anemometer on post-office building, 74 feet above ground) from midnight to 6 o'clock on these 15 mornings was 5.4 miles, and the average relative humidity at the Vicksburg station at 7 a. m. on the dates in question was 74 per cent. The greatest difference, 13.3°, occurred on the morning of March 3, when the average hourly wind velocity was 3.7 miles and the relative humidity at 7 a. m. was 58 per cent, the lowest observed at that hour during March.

Detailed records for March and April are given in Table 1. Briefly tabulated results of the investigation are as follows:

Months.	Stations.	Temperature.			
		Mean.	Maximum.	Minimum.	Greatest daily range.
October	Vicksburg	62.7	83.3	41.0	29.0
	Station A	60.6	84.0	32.3	37.7
	Station B	62.2	84.0	34.0	35.0
November	Vicksburg	60.8	83.0	33.0	31.2
	Station A	58.4	84.0	27.3	38.4
	Station B	59.0	84.8	31.5	34.0
March	Vicksburg	68.5	87.6	43.0	31.9
	Station A	67.2	88.8	36.0	37.4
April	Vicksburg	62.2	84.6	40.0	29.6
	Station A	61.2	86.0	30.3	38.4

Temperature departures at Station A, as compared with the Vicksburg station:

	October.	November.	March.	April.
Mean temperature	-2.1	-2.4	-1.3	-1.0
Mean minimum temperature	-5.0	-5.8	-3.4	-3.3
Mean maximum temperature	+0.8	+0.9	+0.8	+1.3
Average difference in minimum temperatures on generally clear mornings.	-8.2	-8.7	-8.1	-8.9
Average difference in minimum temperatures on generally cloudy mornings.	-1.4	-0.7	-1.4	-1.2
Greatest daily difference in minimum temperatures.	-12.3	-12.7	-13.3	-11.2

Temperature departures at Station B, as compared with the Vicksburg station:

	October.	November.
Mean temperature	-0.5	-1.8
Mean minimum temperature	-2.0	-4.7
Mean maximum temperature	+1.1	+1.2
Average difference in minimum temperatures on generally clear mornings.	-5.6	-6.0
Average difference in minimum temperatures on generally cloudy mornings.	-0.1	-0.4
Greatest daily difference in minimum temperatures	-10.4	-11.4

It will be noted that altho Station B was 64 feet lower than Station A, the lowest temperatures occurred at the latter place. This is undoubtedly due to a marked difference in the topographical surroundings of the two stations. Station A, being in a narrow valley with rather steep bluffs on either side, was subject to the influence of air drainage to a much greater degree than Station B. On still, clear nights, the lower strata of air on the hills and hillsides are cooled by radiation, and this cooler and therefore heavier air moves down the valleys in much the same manner that water drains on uneven ground. As this process continues thruout clear nights the valleys become filled with air having a lower temperature than that on the adjacent hills.

During the series of observations frost occurred on twelve mornings: on these the hourly wind velocity averaged 5.4 miles, and the minimum temperature at Station A averaged 8.7° lower than the minimum temperature at the Vicksburg station; the greatest variation was 12.3°, and the least, 5.7°. On October 29 heavy frost formed on low ground, copious deposits being noted on small bridges, but no frost appeared on high ground. The difference is probably due to the higher wind; for the average hourly wind velocity, from midnight to 6 a. m., as shown by the Vicksburg anemometer, 74 feet above ground, was 9.5 miles. On the morning of November 30 there was a temperature difference of 11.0°, with a wind velocity of 9.3 miles.

During periods when dense low clouds prevailed the temperature readings at the three stations showed a close agreement, the night temperatures in the valleys being sometimes slightly higher than at the Vicksburg station.

As a result of these special observations and a previous study of this subject, I offer the following suggestions with a view to securing greater uniformity in the making of frost observations.

Instructions are now in force directing that snow and ice observations be made at places designated by officials in charge of stations.

During periods when low temperature is liable to prove destructive to vegetation, frost reports are given wide dissemination by telegraph, and it would therefore seem that it is just as essential to require that frost observations be made at definite places as it is in the case of ice and snow observations.

Whether an observer finds light frost before completing a morning telegraphic report may sometimes depend upon the extent of his investigation. At some stations the conditions are such that it might work a hardship on an observer to require him to visit a certain designated place for the purpose of making a frost observation in addition to taking the regular morning observation. However, at practically all such stations the office force consists of two or more men, one of whom could make the frost observation and report the same, probably by telephone, to the observer who prepares the telegraphic report. This plan has been in satisfactory operation at Vicksburg during the past seven years.

Where frost observations are made in a definite place, the frost record for any year is directly comparable with that of any other year, even tho changes in the office force occur frequently. Altho the frost records of the Weather Bureau now show a high degree of accuracy, it is believed that more system in the manner of making the observations would result in still greater accuracy.

I would further suggest that at stations where ice and snow and (in case the foregoing plan is adopted) frost observations are made, the location of the places selected for making such observations be noted in the "station memorandum book". In case it should be deemed advisable to make any change in these locations, such changes should also be noted in the "station memorandum book", with reasons therefor, so that by reference to this book these places could be quickly found.

THE PHILIPPINE WEATHER BUREAU.

The Director of the Philippine Weather Bureau, Rev. José Algué, S. J., thru the assistant director, José Coronas, S. J., calls attention to the fact that the observers and employees, both of the observatory and of the meteorological stations thruout the islands, are not mostly Spaniards, as stated in the MONTHLY WEATHER REVIEW for November, 1906, page 517, but are native Filipinos, altho they bear Spanish names; and that, moreover, the only Jesuits actually engaged in the Philippine Weather Bureau are the five officers who constitute the staff of the Manila Central Observatory. He adds:

"Whilst greatly appreciating the courteous praise given our work in the Philippines, we desire that due credit be given to the native observers, whom we find well qualified for such work."—C. A.

MAY WEATHER AT BANGOR, MAINE.¹

According to the monthly report of the weather compiled by Bangor's veteran observer, F. S. Jennison, the month of May was not such a bad one after all. He furnishes a list of the average temperatures for the month of May for the past fifteen years, and during this time, from the point of average, the past month has been the coldest, but the difference in the temperature has been but a very few degrees. The month would not have seemed so cold had it not been for the prevalent winds from the north and northwest. In 1902 the month of May was nearly as cold as the month just past, there being hardly

a noticeable difference in the average temperatures of the two months.

On May 7 it snowed for several hours, but it melted almost as soon as it fell. The heaviest rain of the month came on the 27th and 28th. There was a heavy frost May 21, and all during that week there were slight frosts. The mercury stood at 76° on the 19th, which was the warmest day of the month.

The following is the list of the average temperatures for the month of May for the past fifteen years:

Years.	6 a. m.	Noon.	6 p. m.
1907.	35	55	36
1906.	45	62	57
1905.	39	58	52
1904.	42	65	59
1903.	43	67	60
1902.	35	54	46
1901.	36	63	49
1900.	36	52	46
1899.	39	62	51
1898.	36	64	54
1897.	39	55	47
1896.	43	62	55
1895.	49	67	54
1894.	44	61	51
1893.	40	60	53

MAY—PAST AND PRESENT.¹

By E. D. LARNED. Pated Thompson Hill, Windham County, Conn., June 1, 1907.

No, this is not the worst May experienced. It has not even broken my 56-year record. That feat was accomplished in 1882 with its mean temperature below 50°. In the matter of snow it had no snow worth mentioning, only a four hours' fall on the 11th, which did not even whiten the ground. Here is a sample from Ashford Town Book:

On the fifth day of May, 1761, a very
Stormy day of snow—an awful sight—
The trees green and the ground white;
The sixth day the trees on the blow
And the fields covered with snow.

EBENEZER BYLES, *Town Clerk.*

Woodstock, May 1, 1761.—The snow began in the morning about sunrise as hard as most ever was known in the winter and was attended with a hard northeast wind. Snowed hard till sundown.

May 19, 1763.—A bad snowstorm.

In recent years we have from Doctor Robbins:

May 10, 1831.—Ground mostly covered with snow. School children threw snowballs and sang gleefully.

"On the 21st of May
The snow lay in the way" in 1842.

And as for cold, Rev. Abel Stoles reports May 31, 1764:

At night the severest frost in memory.

Our Thompson journalist, Joseph Joslin, agrees with Doctor Robbins in reporting the severities of 1816, with more picturesque detail, such as "Very exceeding cold", "A very large black frost", "Ice froze as hard as window glass", "Ice on grass top like sheet", "Wore coat, jacket, surtout, and wig and none too hot". The perversity of this season extended till late autumn, causing great distress and scarcity. My father harvested his bushels of "nubbins" in great coat and mittens.

Victoria's accession to the throne was noted as the fulfillment of an ancient prophecy, viz:

By the power to see through the ways of Heaven
In one thousand eight hundred and thirty-seven,
Shall the year pass away without any spring
And on England's throne shall not sit a King.

The May of 1882, mean temperature 49.27°, exceeded all within my period of observation in unmitigated severity and backwardness. Twenty-five of its mornings were below frost point. An old friend whose birthday, May 17, had for ninety

¹ This article consists chiefly of a letter from Miss Larned, printed in the Hartford Courant of June 4, 1907. Additions have been made from a personal letter.—EDITOR.

¹ Reprinted from the Bangor Daily Commercial of June 1, 1907.